00-2-027 Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Huntington

Serial No. 09/921,039 Art Unit: 2879

Filed: 8/2/01 Examiner: A. Perry

For: Double Layer Electrode Coil for a HID Lamp and Method of Making the Electrode Coil

July 23, 2003

Hon. Commissioner of Patents and Trademarks
Washington, D.C. 20231

Sirs:

CERTIFICATE OF MAILING UNDER 37 CFR 1.8
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July 23 2003

Robert F. Clark

Robert F. Clark Reg. No. 33,853

Response

In response to the Office Action dated 4/24/03 with respect to the above-identified application, the applicants hereby request further examination and reconsideration of the instant application in view of the following remarks.

REMARKS

The Applicants' attorney confirms the election to prosecute claims 11-15 (Group II) which was made in a telephone conversation with the Examiner in response to the Examiner's restriction requirement.

A supplemental information disclosure statement is attached.

The rejection of claims 11-15 under 35 USC 102(b) as being anticipated by Japanese patent JP 79001110 B is respectfully traversed. In a telephone conversation with the Examiner on April 29, 2003, the Applicants' attorney confirmed with the Examiner that this rejection is actually

FAX

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ATTENTION: Examiner Anthony Perry Art Unit 2879

For Application Serial No. 09/921,039

Dear Examiner Perry,

Attached is a copy of the Stamped Return Postcard from the USPTO and the response which was filed in the above-identified case on July 23, 2003.

Thank you.
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OSRAM SYLVANIA

C-

Receipt is acknowledged of a paper in the application of:

Inventor: Huntington et al.

Ser. No.: 09/921,039

Filing Date: 8/2/01

For: Double Layer Electrode Coil for a HID Lamp + Method of Making the Electrode Coil.

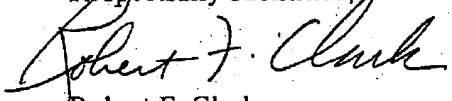
Docket: 00-2-027

Response (10); Information Disclosure Statement (1 pg. in triplicate); Form PTO-1449 (1); JP 50-85181 (13 pp. incl. translation); Postcard

directed to JP 50-85181 and that the "JP 79001110 B" reference is in error. In view of this, the Applicants obtained a full translation of JP 50-85181 which is enclosed herewith. The construction of the electrode shown in Fig. 2 of JP 50-85181 is described at page 5 of the translation. The inner coil 6 is first coated with a suspension of the electron-emitting substance and then the outer coil 7 is wrapped around the electrode. Since the electro-emitting material is deposited before the outer coil is added, the outer coil is not in direct contact with the inner coil. Therefore, the Applicants respectfully assert that the cited reference does not teach or suggest a second wire directly on the first wire wherein a first turn of the second wire touches a first turn of the first wire and a last turn of the second wire touches a last turn of the first wire. Since the reference does not teach or suggest this limitation, the Applicants respectfully assert that the claimed invention is not anticipated by JP 50-85181.

In view of the foregoing amendment, it is believed that the Examiner's rejections have been overcome and that the application is in condition for allowance. Such action is earnestly solicited.

Respectfully submitted,



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November 30, 1973

2000 Yen

Patent Application 8

Director, Patent Office

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1. Title of the Invention Electrode for Discharge Lamp

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5. Contents of Attached Pages:
   (1) Specification 1 copy
   (2) Drawings 1 copy
   (3) Power of Attorney 1 copy
   (4) ~~Request for Application Examination 1 copy~~ (illegible) [seal]

Specification

1. Title of the Invention

Electrode for Discharge Lamps

2. Scope of Patent Claim

An electrode for discharge lamps, characterized in that after an electron-emitting substance with the chemical formula $Ba_{2-x}Sr_xCaWO_4$ (here x is 0.1 to 0.5) is applied over an electrode coil made from a refractory metal that has been wrapped around an electrode core wire made from refractory metal, it is heated at a high temperature in an atmosphere such as hydrogen, a vacuum, etc., to firmly adhere said electron-emitting substance to said electrode coil.

3. Detailed Description of the Invention

The present invention relates to improvement of electrodes that are used in high-pressure mercury lamps, particularly high-pressure sodium lamps in which sodium metal has been sealed. Sodium, mercury, and further, xenon, for instance, as the starter gas, are sealed inside the light-emitting tube made of a translucent ceramic for high-pressure sodium lamps. An electrode made from a refractory metal is placed at

the end of this discharge lamp and an electron-emitting substance is generally added to these electrode in order to facilitate lighting of the lamp and to provide sufficient electron radiation during operation.

In the past, a mixture of an alkaline-earth metal oxide, such as barium oxide or calcium oxide, and a heat-resistant oxide, such as aluminum oxide, thorium oxide, or beryllium oxide has been used as this electron-emitting substance.

When this type of electron-emitting substance is used for the electrode of a high-pressure sodium lamp, the free beryllium that has been produced by dissociation of the beryllium oxide during operation of the lamp is supplied to the electrode tip to facilitate the radiation of electrons. However, oxygen is emitted at the same time inside the light-emitting tube and the sodium that is sealed inside the tube is oxidized. As a result, there is a reduction in the amount of metallic sodium, and the sodium vapor pressure during operation of the lamp decreases. As a result, the lamp tube voltage rises and there are also problems such as flickering.

The use of barium calcium tungstate (Ba_2CaWO_4), which has generally been used in the past as a cathode substance for electrodes, as the electron-emitting substance, is effective in solving these problems. The reason for this appears to be that the reaction by which the free barium that is necessary for electron emission is produced from Ba_2CaWO_4 is not accompanied by the generation of oxygen, as shown by the following formula, and therefore, the above-mentioned oxidation of sodium does not occur:

$$2Ba_2CaWO_4(s) + W(s) \rightarrow BaWO_4(s) + 2CaWO_4(s) + 3\ Ba(g)$$

Nevertheless, there is a problem when the above-mentioned Ba_2CaWO_4 is used for the electrode of a high-pressure sodium lamp in that the inside surface around the electrodes of the light-emitting tube of the above-mentioned lamp gradually turns black with lighting time and before long there is a reduction in flux. The reason for this appears to be that free barium is produced to excess from the Ba_2CaWO_4 and evaporates from the electrodes and deposits on the inner surface of the light-emitting tube. Another heat-resistant oxide, such as aluminum oxide, silicon oxide, or beryllium oxide, is generally mixed with the above-mentioned electron-emitting substance to counter this type of problem, but there is a disadvantage in that evaporation is not completely prevented or the barium forms a compound with these heat-resistant oxides.

The object of the present invention is to eliminate the above-mentioned disadvantages. It presents an electrode for discharge lamps, characterized in that it comprises an electron-emitting substance having the chemical formula $Ba_{2-x}Sr_xCaWO_4$ wherein the value of x is 0.1 to 0.5.

Examples of the present invention will now be described in detail with drawings. Figure 1 is a plane view showing the light-emitting tube of a high-pressure sodium lamp. In the figure, 1 is the light-emitting tube made from a translucent ceramic tube, 2 is the ceramic cap placed at both ends of light-emitting tube 1, and 3 is the heat-resistant metal emission tube made of niobium, etc., that passes through the center of ceramic cap 2 and is attached to this cap in an airtight manner. This emission tube serves as the lead for introduction of current and electrode 4 is attached to the tip of emission tube 3 inside light-emitting tube 1. Sodium as the light-emitting metal and mercury as the buffer gas and/or xenon as the starter gas are sealed inside light-emitting tube 1.

Figure 2 is an enlarged cross section showing an example of the electrode for discharge lamps of the present invention. Reference 5 is the electrode core wire made from a refractory metal such as tungsten, 6 is the inner coil made from tungsten that has been wrapped around electrode core wire 5, and 7 is the outer coil made from tungsten that has been further wrapped around the outside of inner coil 6. Incidentally, coil 6 can also be wrapped so that space for more electron-emitting substance is formed. Moreover, electron-emitting substance 8 made from the above-mentioned $Ba_{2-x}Sr_xCaWO_4$ is filled in the spaces that are made by inner coil 6 or the spaces that are made by outer coil 7.

The $Ba_{2-x}Sr_xCaWO_6$ used as electron-emitting substance 8 is made, for instance, by the following process: Each of the following powders: barium carbonate, strontium carbonate, calcium carbonate, and tungsten trioxide, is made with a ball mill and the mixed powder is introduced into an alumina vessel and heated for approximately 30 minutes at 1,400°C in air. The $Ba_{2-x}Sr_xCaWO_4$ powder obtained in this way is finely crushed with a ball mill. This powder is mixed with butyl acetate alcohol or n-propyl alcohol to make a suspension and this is applied to the electrode coils. It is applied by painting the suspension on after wrapping the inner coil around the core wire, or by immersing inner coil 6 in the above-mentioned suspension. This is then dried using an ultraviolet lamp, etc., and outer coil 7 is wrapped around the electrode. The suspension can be applied by the same methods when it is applied to both inner coil 6 and outer coil 7.

In order to prevent the electron-emitting substance from coming off upon mechanical impact, etc., the electrode to which electron-emitting substance has been applied is heated at a high temperature in an atmosphere such as hydrogen, a vacuum,

etc., in order to firmly adhere the above-mentioned electron-emitting substance to the electrode coil.

If x in the chemical formula $Ba_{2-x}Sr_xCaWO_4$ is smaller than 0.1, the effect of adding strontium will be small and it will be difficult to prevent evaporation of the barium. Moreover, if x exceeds 0.5, very little barium will be produced from the above-mentioned substance and as a result, insufficient barium will be supplied to the tip of the electrode and the temperature at the tip of the electrode will rise and the evaporation of tungsten will increase.

The exact reason why evaporation of barium is prevented by adding strontium to Ba_2CaWO_4 to form $Ba_{2-x}Sr_xCaWO_4$ is not clear, but it is estimated that the above-mentioned tungstate becomes a compound that is more stable thermally when strontium is added and therefore, the reaction by which free barium is produced rarely occurs.

Next, an electrode comprising an electrode core made from tungsten with a diameter of 1.2 mm, an inner coil made from tungsten with a diameter of 0.6 mm, an outer coil made from tungsten with a diameter of 0.6 mm, and an electron-emitting substance comprised of $Ba_{1.8}Sr_{0.2}CaWO_4$ filling in the spaces of the inner coil, all inside a translucent ceramic tube with an inner diameter of approximately 8 mm and a length of approximately 113 mm was constructed as an example of the present invention. A 400 W high-pressure sodium lamp was made and lifetime tests were conducted. As a result, there was very little blackening of the inner surface near the electrode of the light-emitting tube after 6,000 hours of being illuminated and the flux retention rate was approximately 90%.

When $Ba_{1.5}Sr_{0.5}CaWO_4$ was introduced between the spaces made by the inner coil under the same conditions as described above, the flux retention rate after being illuminated for 6,000 hours was approximately 85%.

Incidentally, when Ba_2CaWO_4 was introduced in the spaces made by the inner coil under the same conditions as described above, the flux retention rate after being illuminated for 6,000 hours was approximately 65%, with flux decreasing due to blackening of the light-emitting tube.

As previously explained, by using the electrode of the present invention, it is possible to obtain a lamp that shows less blackening of the light-emitting tube walls than in the past and therefore, reduced flux deterioration.

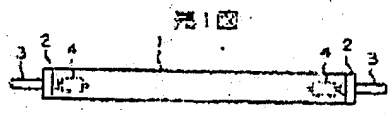
4. Brief Description of the Drawings

Figure 1 is a plane view showing a light-emitting tube of a high-pressure sodium lamp and Figure 2 is an enlarged cross section showing an example of the electrode of the present invention.

In the figures, 5 is the electrode core, 6 is the inner coil, 7 is the outer coil, and 8 is the light-emitting substance.

Agent Nobuichi Kuzuno

Figure 1



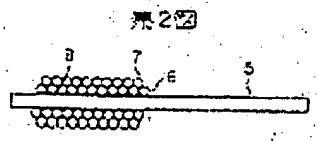


Figure 2

6. Inventors not previously listed

All three have the following address:

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